

Evaluating Cumulative Ecosystem Response to Habitat Restoration Projects in the Lower Columbia River and Estuary -2007 update



Acknowledgements

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The primary goal: Develop and employ methods to quantify cumulative effects of multiple restoration projects on ecosystem functions supporting listed salmon in the Columbia River estuary.



- ◆ Cumulative effects assessment methodology
- ◆ Standardized suite of monitoring protocols
- ◆ Field assessments for salmon habitat restoration
- ◆ Management framework to support Corps decisions for the prioritization of estuarine restoration projects



Monitoring Protocols

A common set of measurements

- ◆ Effectiveness monitoring
- ◆ Comparison between sites
- ◆ Data for adaptive management
- ◆ Specific to Lower Columbia

Selection criteria for metrics

- 1) Goal oriented Commonly held restoration goals
- 2) Applicable to wide range of sites
- 3) Diagnostic
 - ◆ Physical drivers
 - ◆ Landform response
 - ◆ Biological response
- 4) Relevant past, present, future
- 5) Accessible “Reasonable” effort

Monitoring Protocols for Salmon Habitat Restoration Projects in the Lower Columbia River and Estuary



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Working Draft Report
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¹ National Marine Fisheries Service
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Core Monitored Metrics

- 1) Hydrology (water elevation)
 - 2) Water quality (Temp, Sal, DO)
 - 3) Elevation (Bathymetry and Topography)
 - 4) Landscape Features (Channel morphology)
 - 5) Vegetation Community
 - 6) Vegetation Planting
 - 7) Fish Community
- } **Physical drivers**
- } **Landform response**
- } **Biological response**

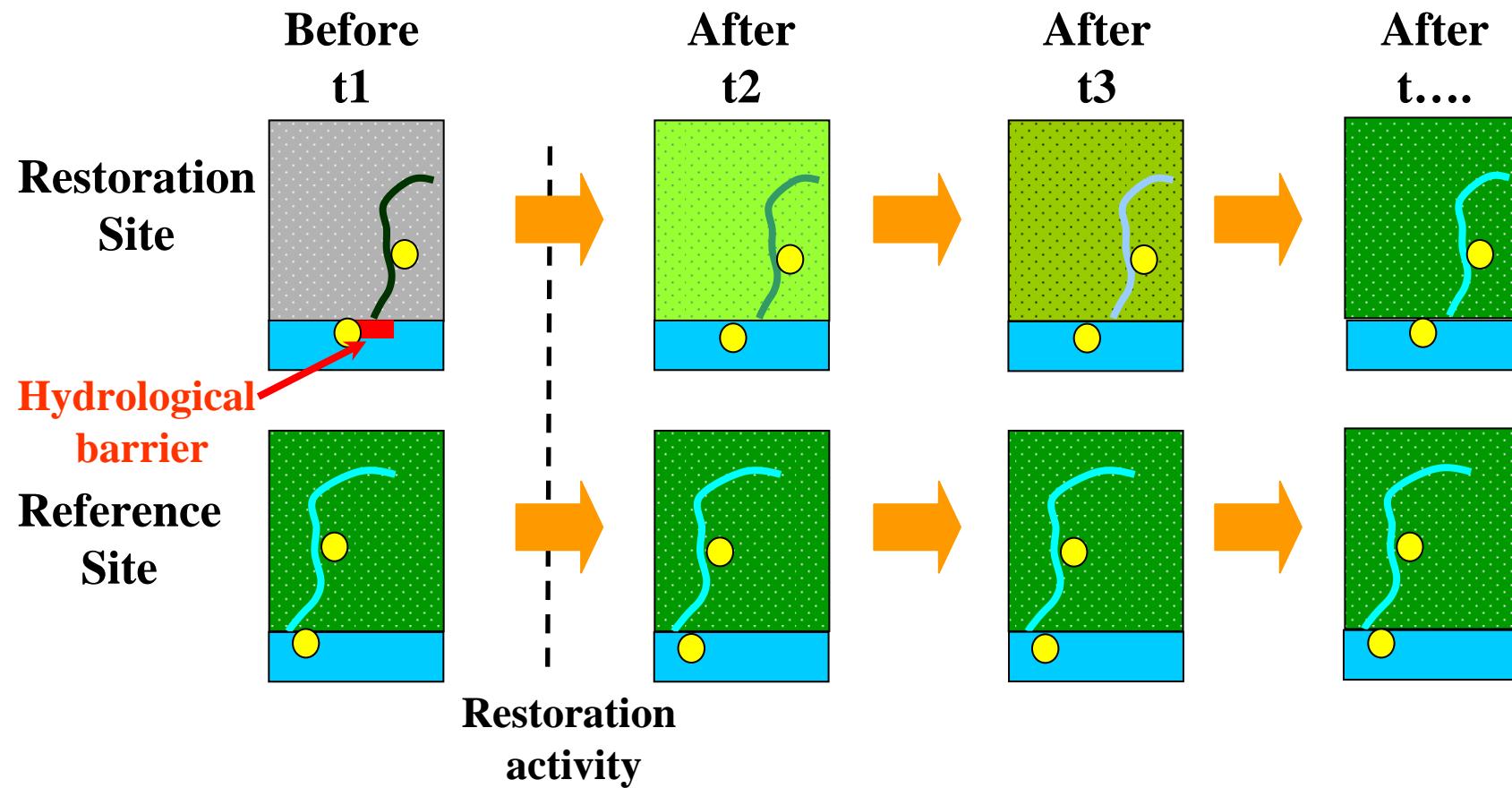
“Higher Order” Metrics

- 1) Fish prey
- 2) Fish residence
- 3) Vegetation biomass
- 4) Material flux



Design considerations

- Restoration and Reference
- Before and After



Field Activity 2005-2007

Activity	2005		2006				2007				
	KF	VS	KF	VS	CI	Swamp	KF	VS	CI	Swamp	JBH
Hydrology & WQ	X	X	X	X		X	X	X			
Elevation	X	X	X	X	X				X	X	X
Landscape Features	X	X	X	X	X		X	X			X
Channel Morph	X	X	X	X		X	X	X	X	X	X
Vegetation	X	X	X	X	X					X	X
Biomass/Litter	X	X	X	X	X	X	X	X	X	X	X
Fish Abundance	X	X	X	X			X	X			
Fish Diet			X	X			X				
Fish Genetics							X				
Material Flux	X	X	X	X	X		X	X	X		X

KF=Kandoll Farm. VS=Vera Slough. CI=Crims Island. Swamp=KF reference.

JBH=Julia Hansen Butler Refuge.

Field Activity 2005-2007

Activity	2005		2006				2007				
	KF	VS	KF	VS	CI	Swamp	KF	VS	CI	Swamp	JBH
Hydrology & WQ	X	X	X	X		X	X	X			
Elevation	X	X	X	X	X				X	X	X
Landscape Features	X	X	X	X	X		X	X			X
Channel Morph	X	X	X	X		X	X	X	X	X	X
Vegetation	X	X	X	X	X					X	X
Biomass/Litter	X	X	X	X	X	X	X	X	X	X	X
Fish Abundance	X	X	X	X			X	X			
Fish Diet			X	X			X				
Fish Genetics							X				
Material Flux	X	X	X	X	X		X	X	X		X

KF=Kandoll Farm. VS=Vera Slough. CI=Crims Island. Swamp=KF reference.
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Field Activity 2005-2007

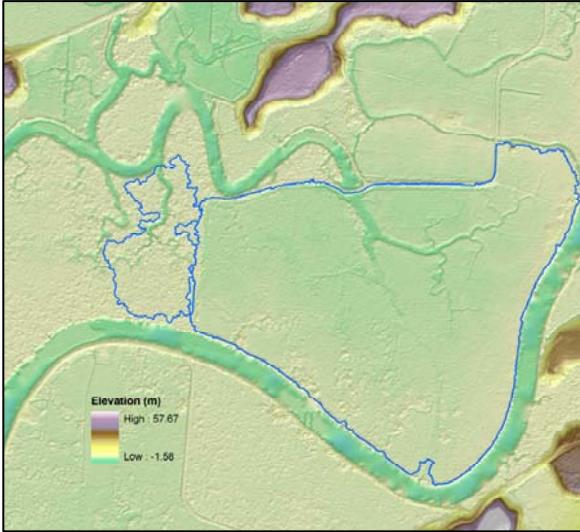
Activity	2005		2006				2007				
	KF	VS	KF	VS	CI	Swamp	KF	VS	CI	Swamp	JBH
Hydrology & WQ	X	X	X	X		X	X	X			
Elevation	X	X	X	X	X				X	X	X
Landscape Features	X	X	X	X	X		X	X			X
Channel Morph	X	X	X	X		X	X	X	X	X	X
Vegetation	X	X	X	X	X					X	X
Biomass/Litter	X	X	X	X	X	X	X	X	X	X	X
Fish Abundance	X	X	X	X			X	X			
Fish Diet			X	X			X				
Fish Genetics							X				
Material Flux	X	X	X	X	X		X	X	X		X

KF=Kandoll Farm. VS=Vera Slough. CI=Crims Island. Swamp=KF reference.

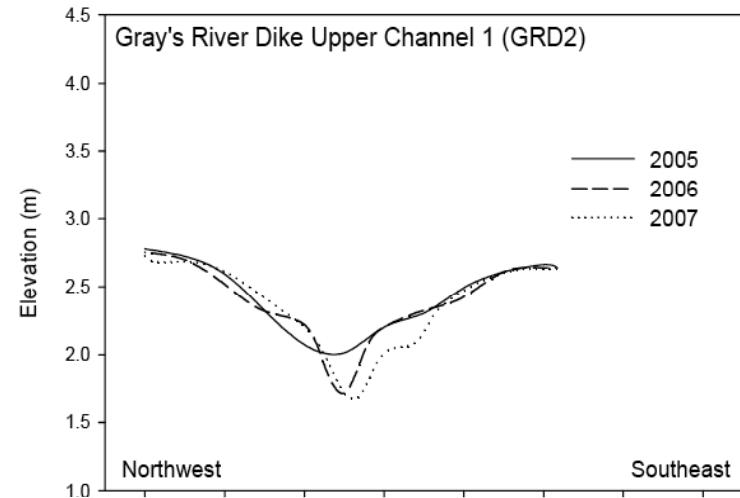
JBH=Julia Hansen Butler Refuge.

Topographic and vegetation responses to hydrological changes

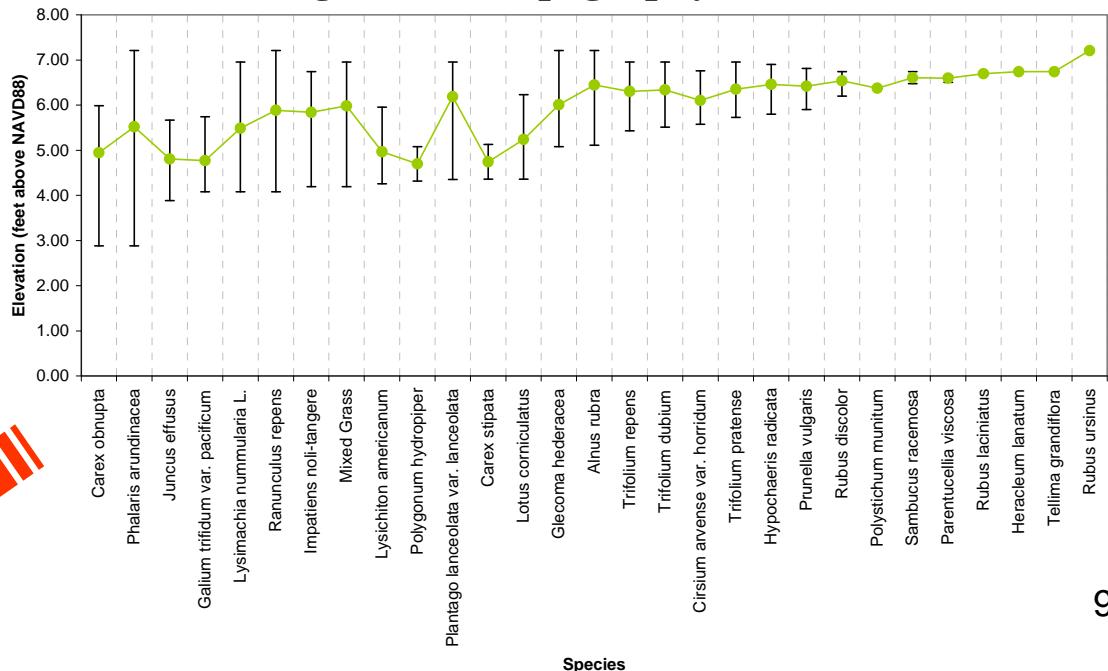
Lidar topographic data



Tidal channel evolution



Vegetation – topography associations



Predictions for
habitat change



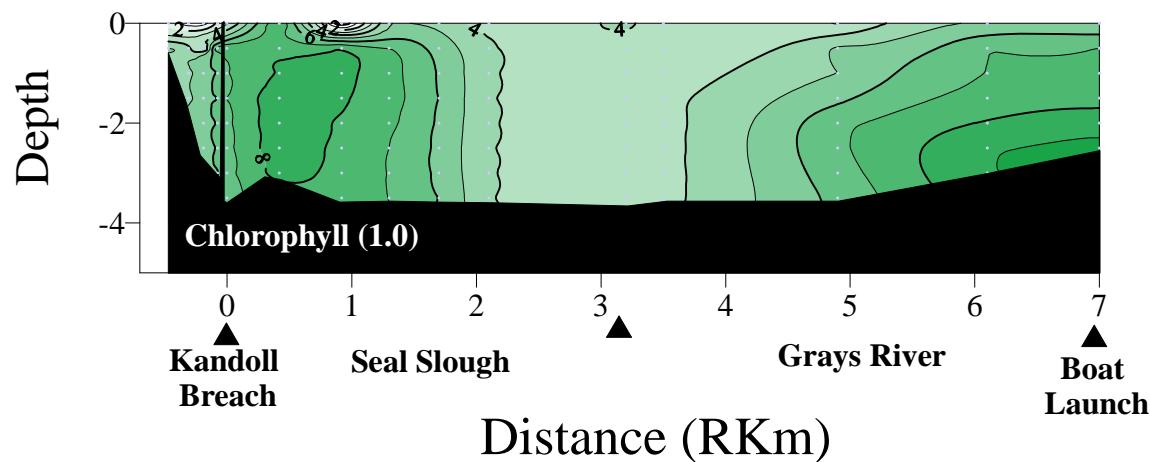
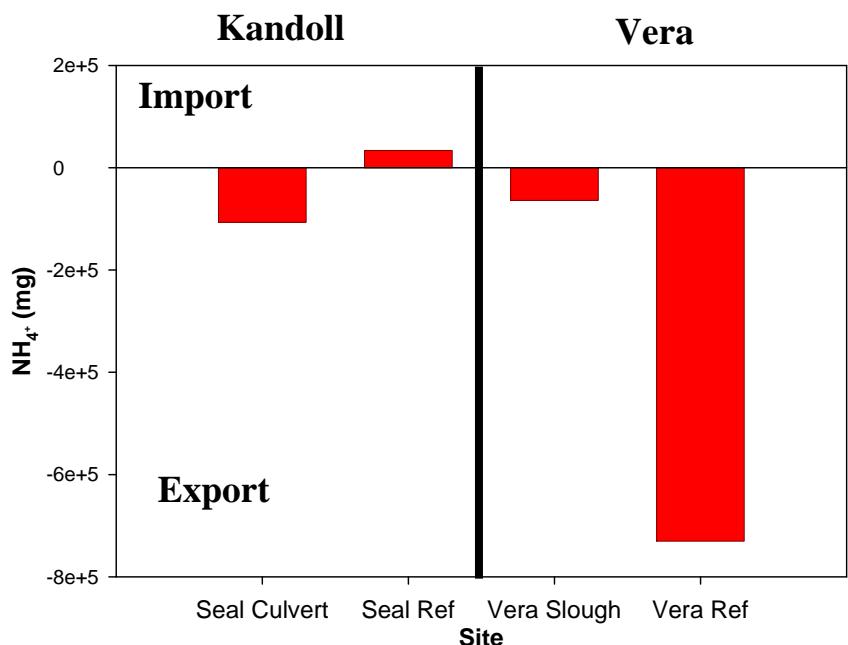
Average percent cover of the dominant plant species at two sampling locations on a restoration site (SSE and SSW) before and after a restoration action.

Scientific Name	Common Name	Before	After	Before	After
		SSE 2005	SSE 2006	SSW 2005	SSW 2006
<i>Juncus effusus</i>	Soft rush	0.9	1.5	14.2	3.9
<i>Phalaris arundinacea</i>	Reed canary grass	27.1	57.0	33.1	56.3
<i>Ranunculus repens</i>	Creeping buttercup	21.5	13.7	6.8	1.8
<i>Rubus discolor</i>	Himalayan blackberry	0.0	0.0	16.8	3.4
<i>Trifolium spp.</i>	Red clover, white clover, sm. hopclover	19.4	0.3	0.0	0.0
n/a	Mixed Grass	49.7	22.5	4.2	3.1

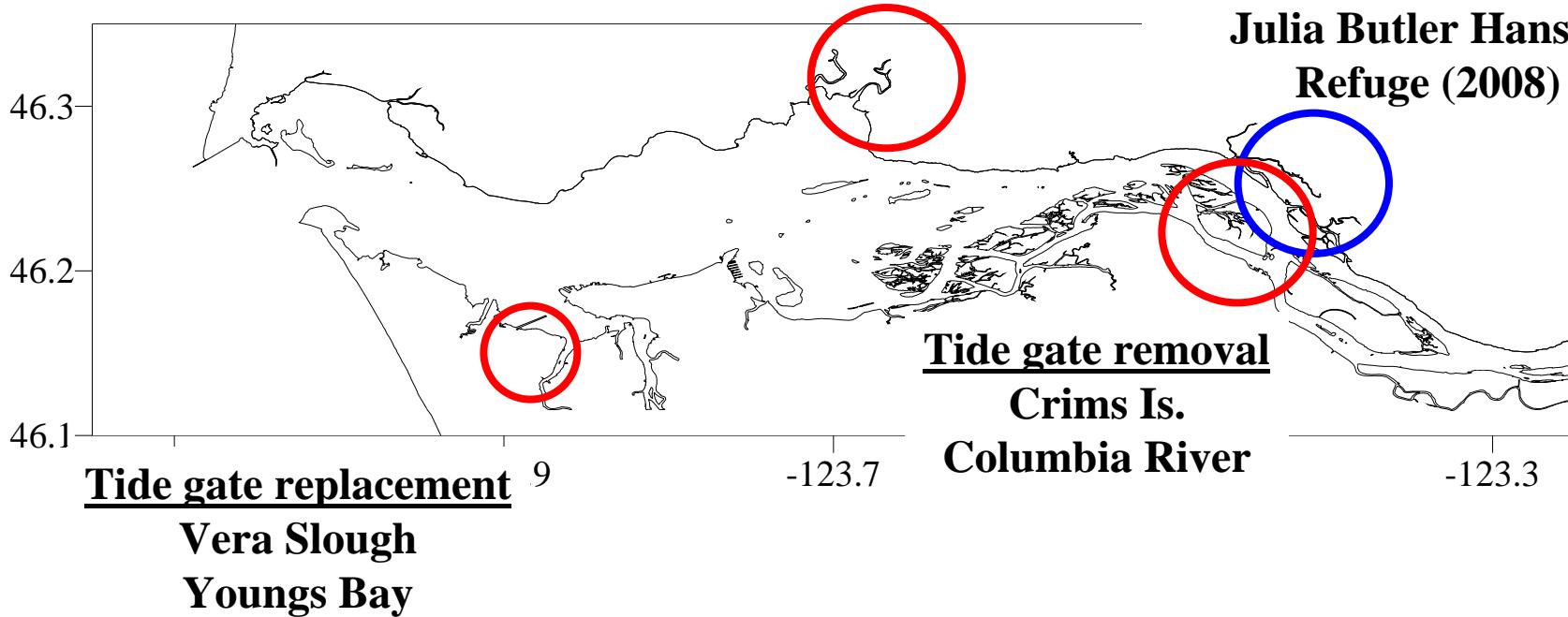
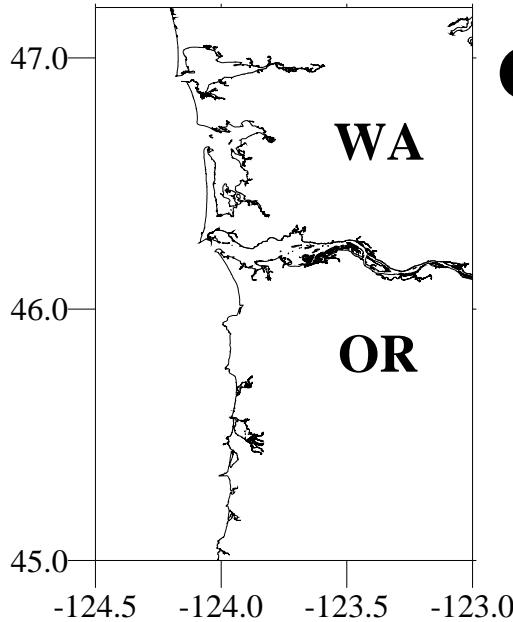
Flux Sampling

- Dissolved components
 - Nitrogen (ammonia, nitrate, nitrite)
 - Phosphate
 - Silicate
 - Chlorophyll
 - Total organic carbon
- Neuston
- Temporal and spatial sampling

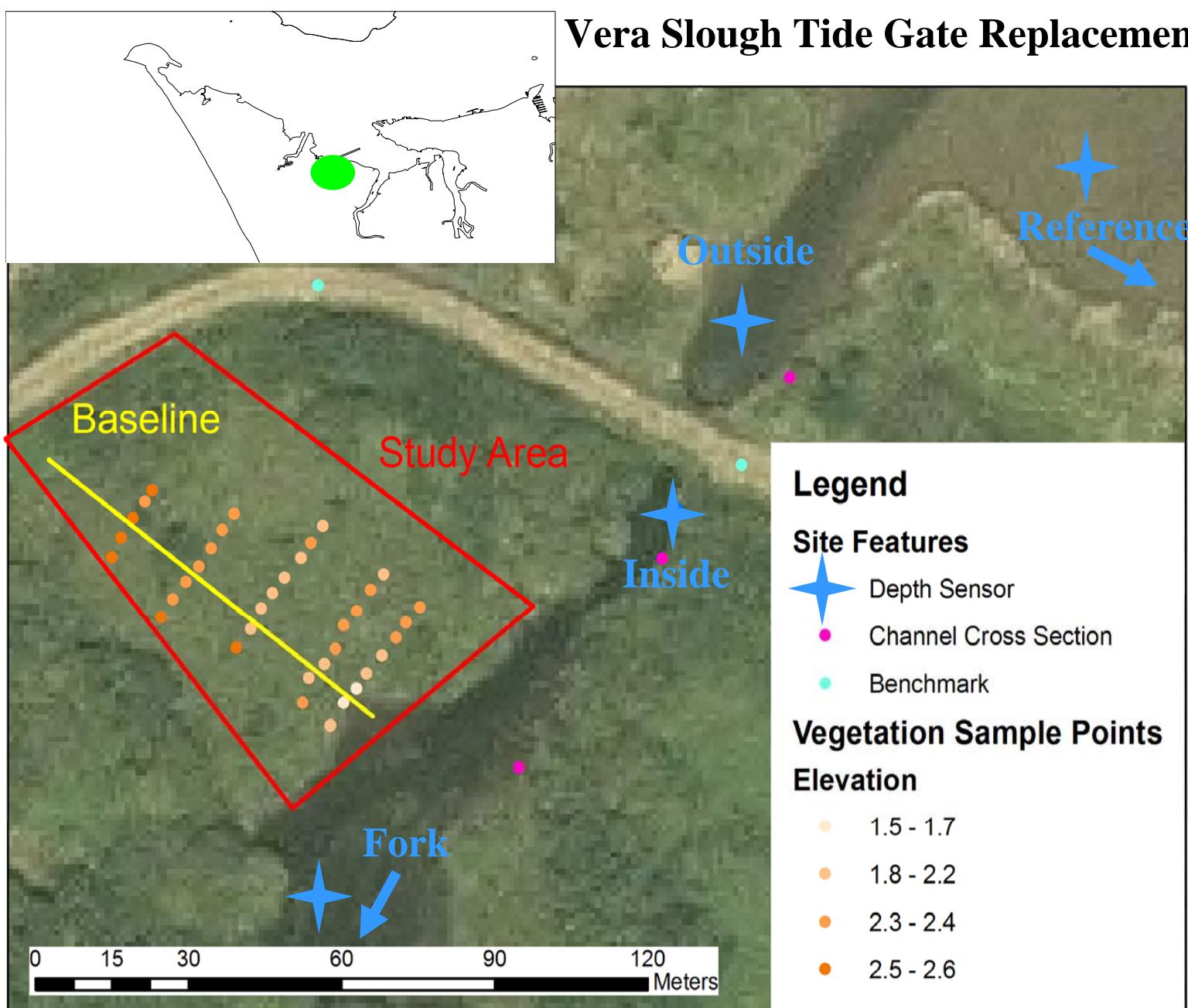
Net Ammonia transport



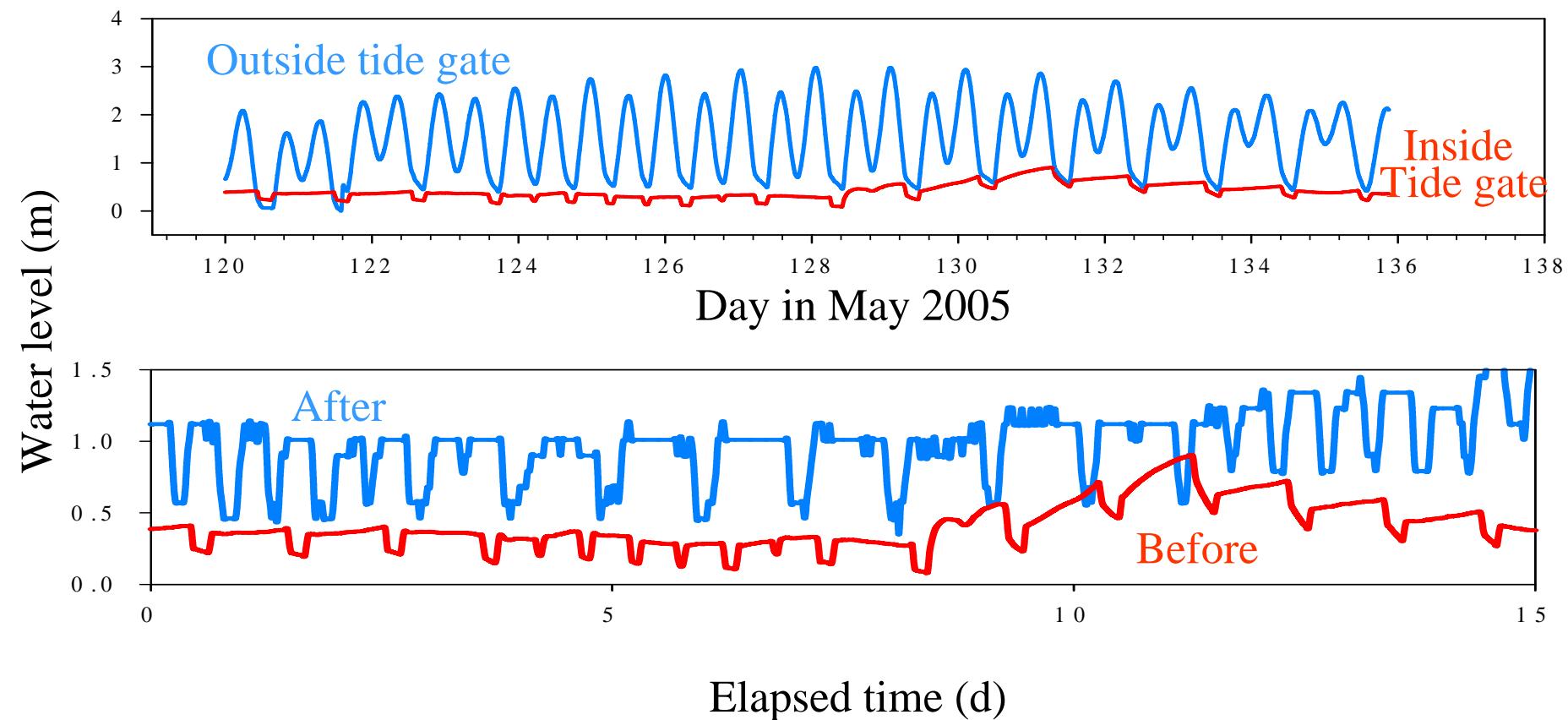
Cumulative Effects Study restoration sites in the Lower Columbia River



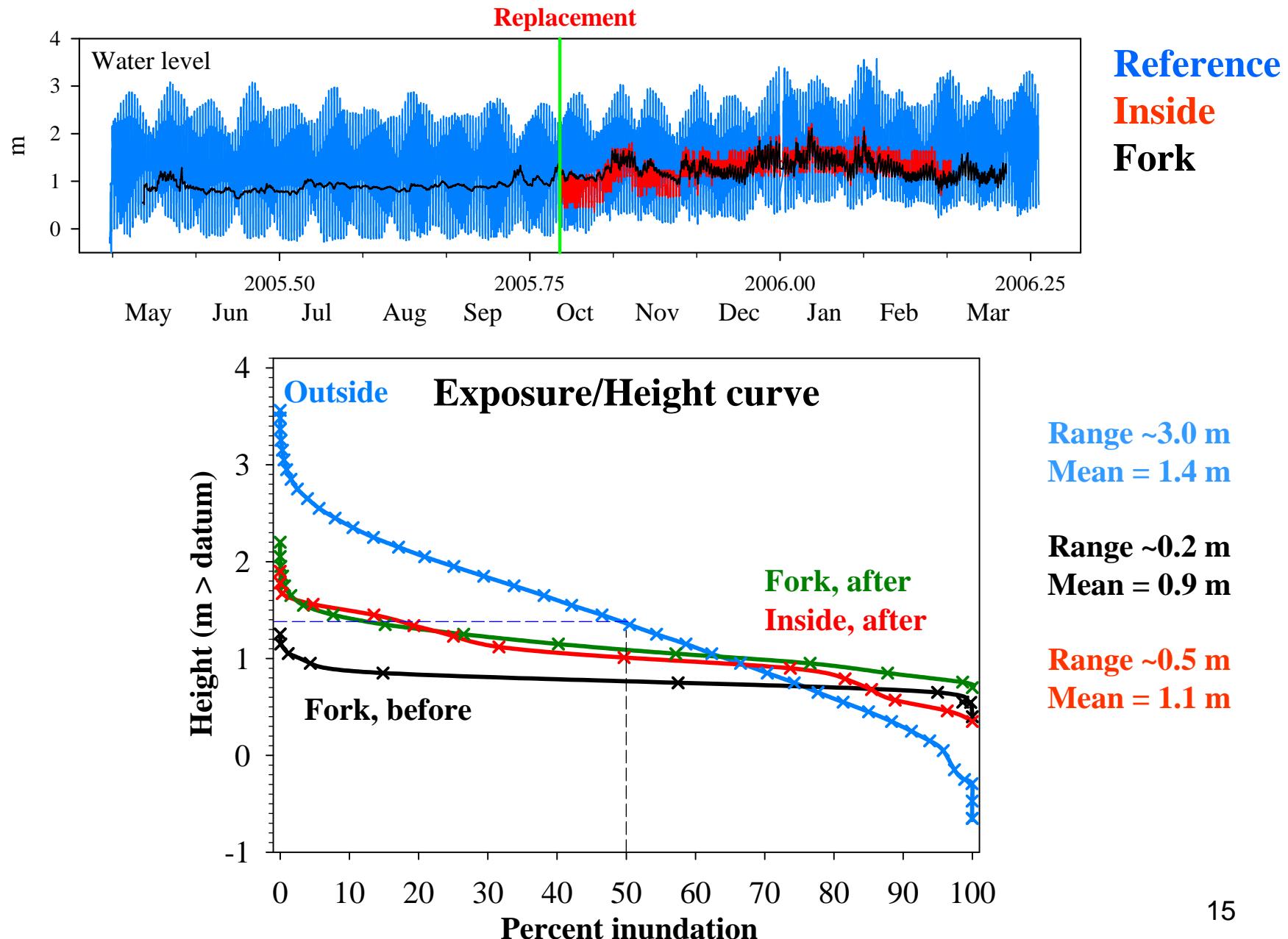
Vera Slough Tide Gate Replacement



Vera Slough hydrography: Before vrs After tide gate replacement

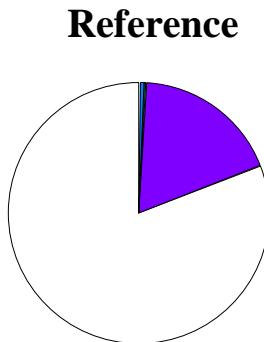
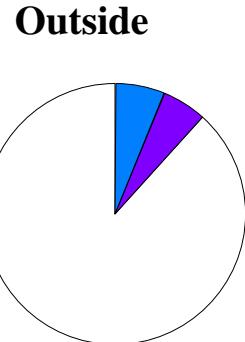
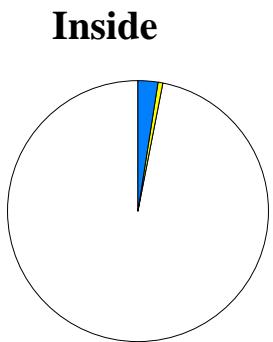


Vera Slough Hydrology

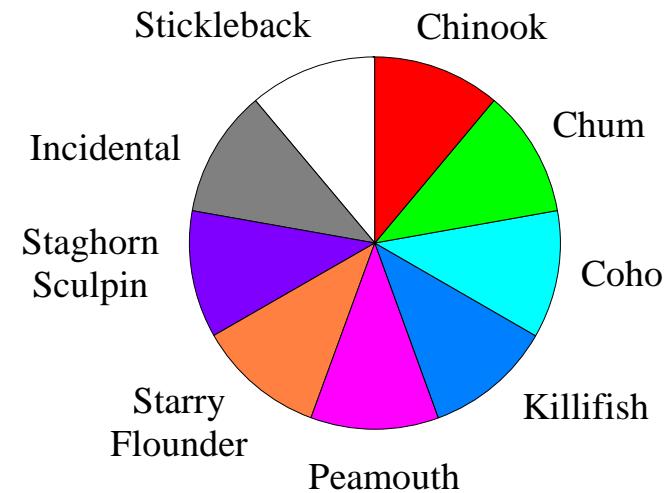
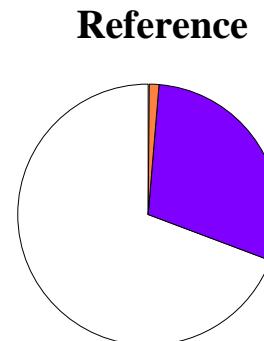
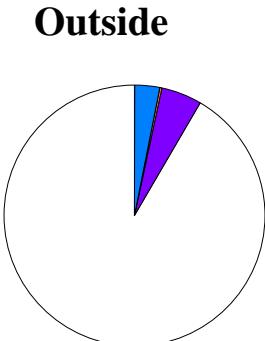
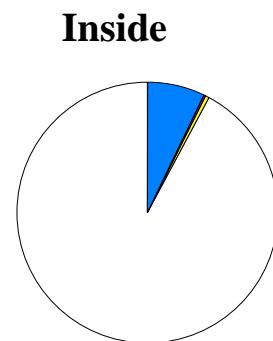


Vera Slough: Fish community structure

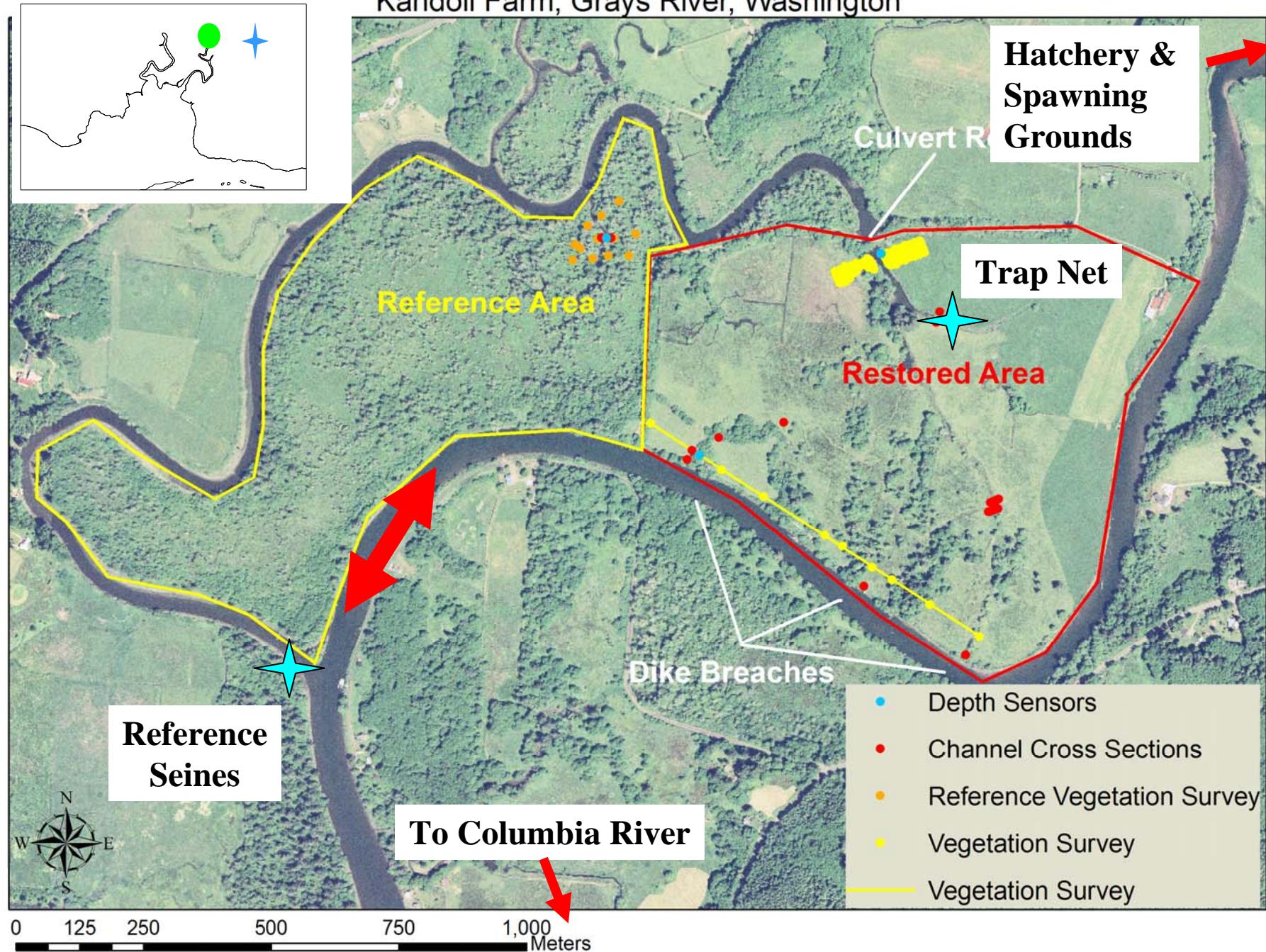
2005



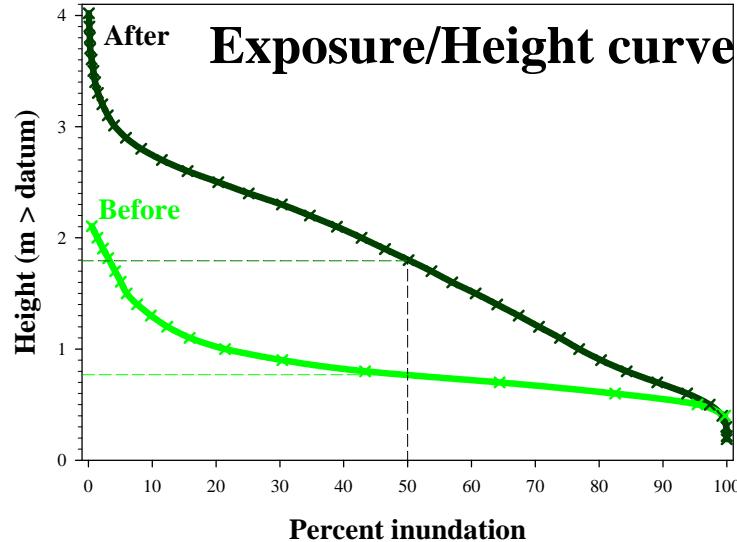
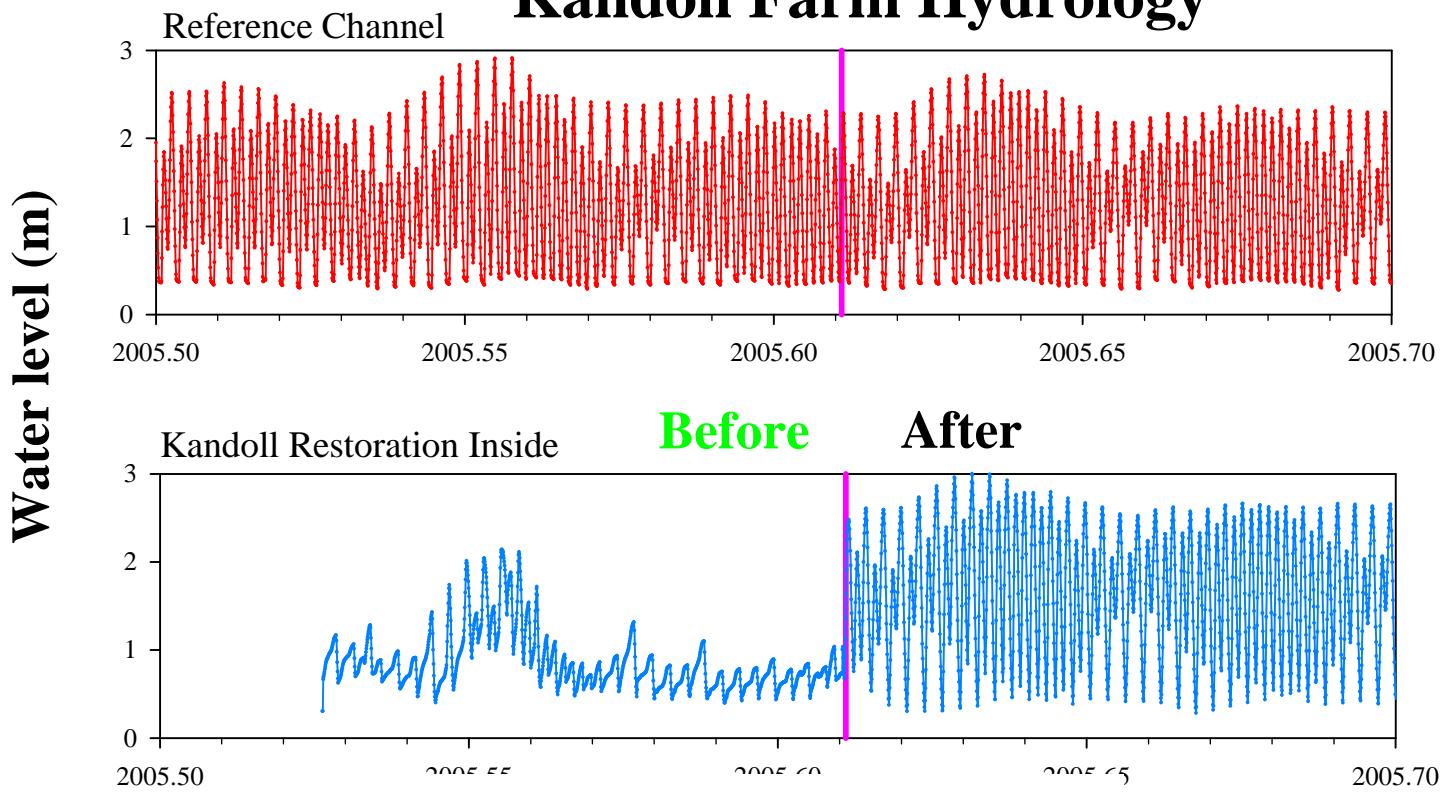
2006



Kandoll Farm, Grays River, Washington



Kandoll Farm Hydrology



Kandoll Farm tide gate removal -before



Terrestrial megafauna

Kandoll Farm tide gate removal -after



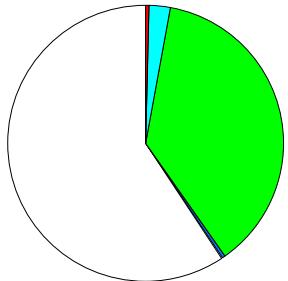
Wetland

Gray River: Fish community structure 2007

Restoration
site

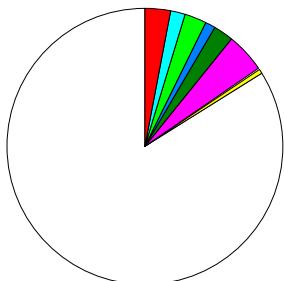
Grays River Reference sites

Inside TN



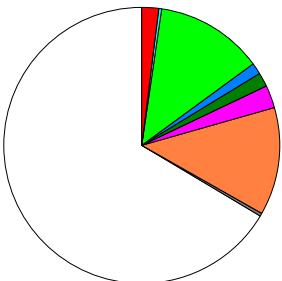
N = 1489
H' = 0.82
S = 6

Seal Slough



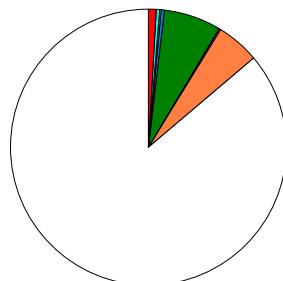
N = 1755
H' = 0.74
S = 11

Johnson



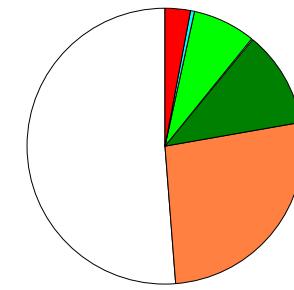
N = 301
H' = 0.76
S = 9

Devils Elbow

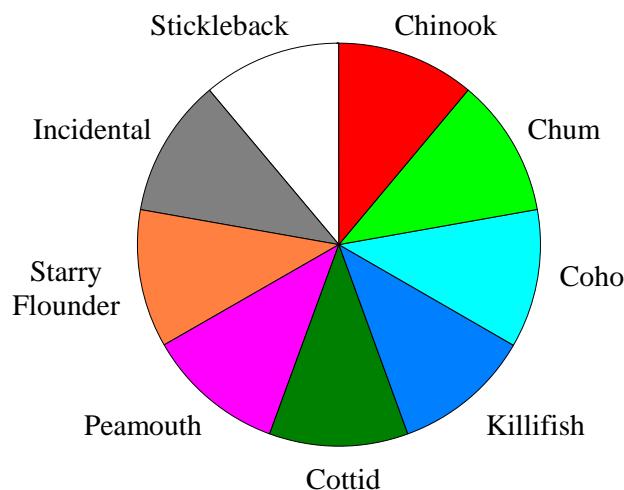


N = 553
H' = 0.58
S = 8

Grays River Mouth



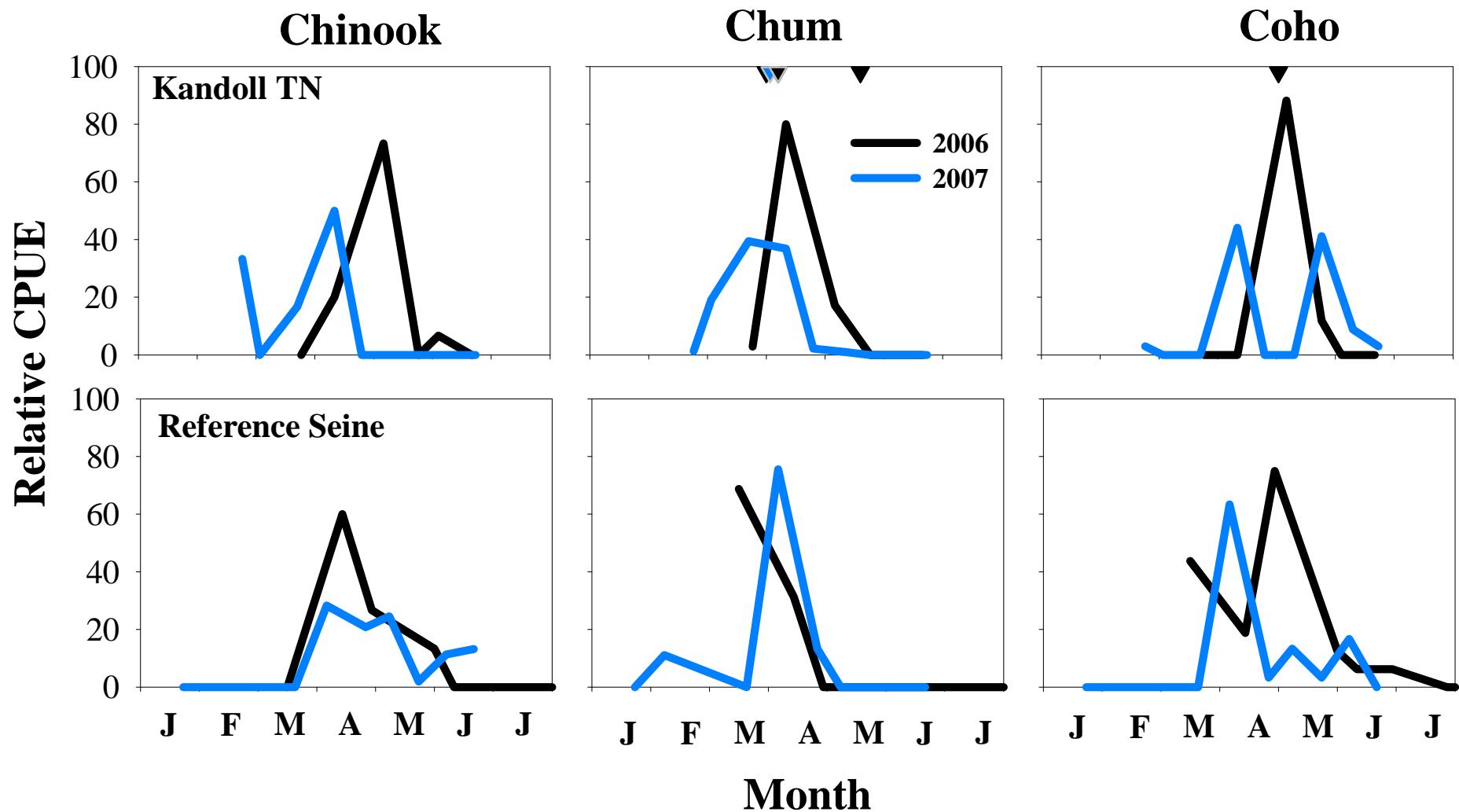
N = 638
H' = 1.27
S = 7



Percent presence

2006 hatchery release: 146000 chum, 321000 coho

2007 hatchery release: 130000 chum, 157000 coho

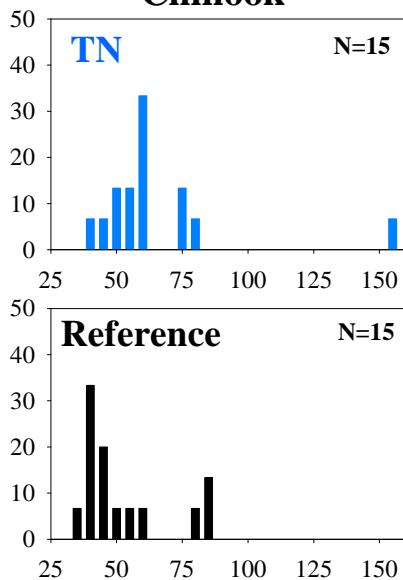


Composite size frequency

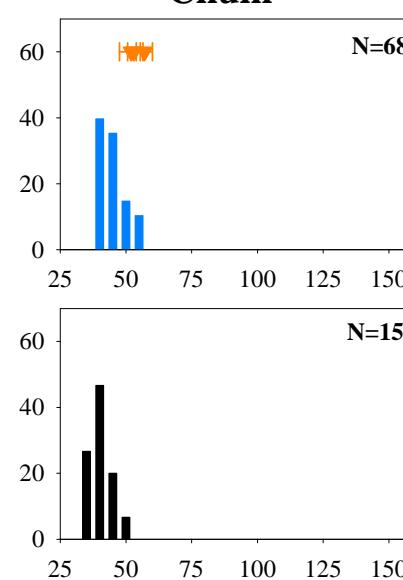
2006

Percent occurrence

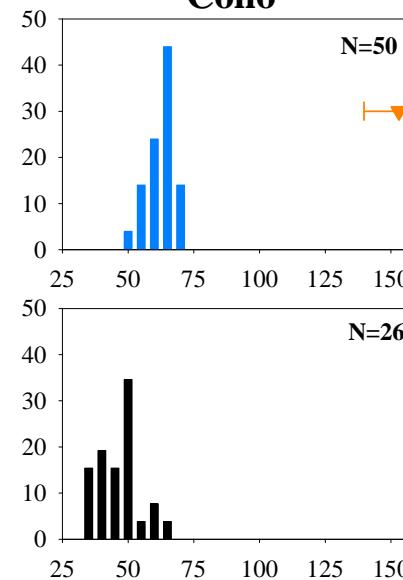
Chinook



Chum



Coho

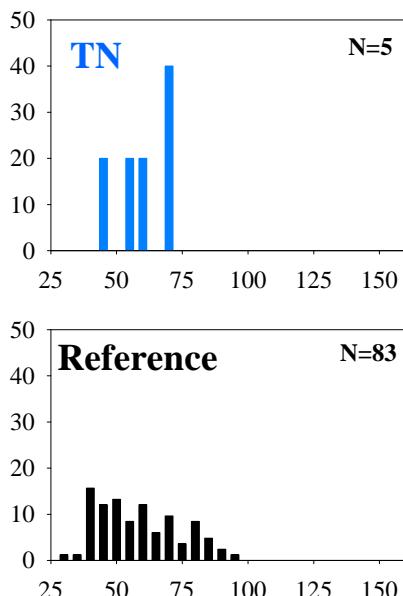


2007

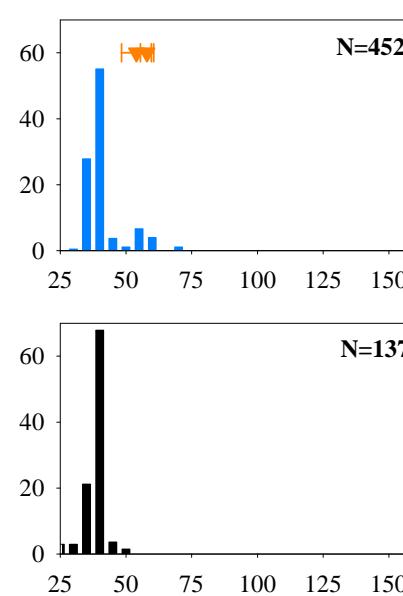
Percent occurrence

TN

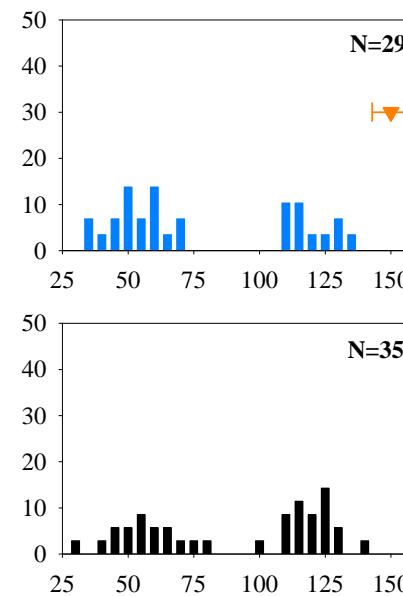
N=5



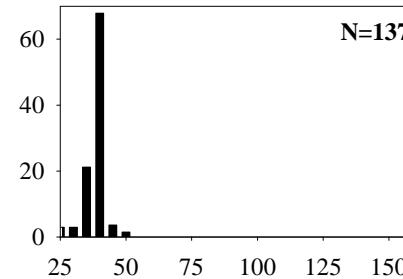
N=452



N=29

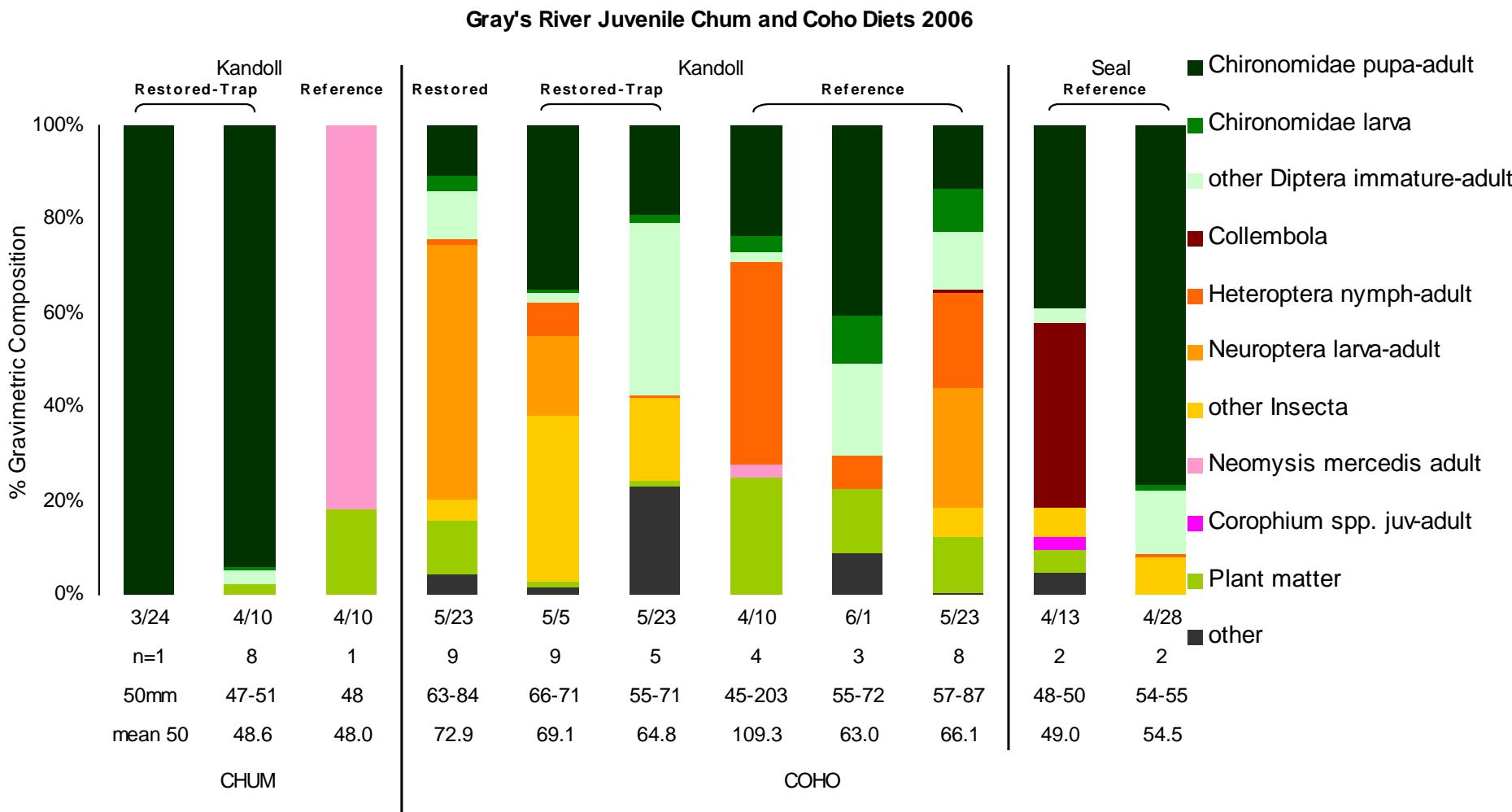


N=35

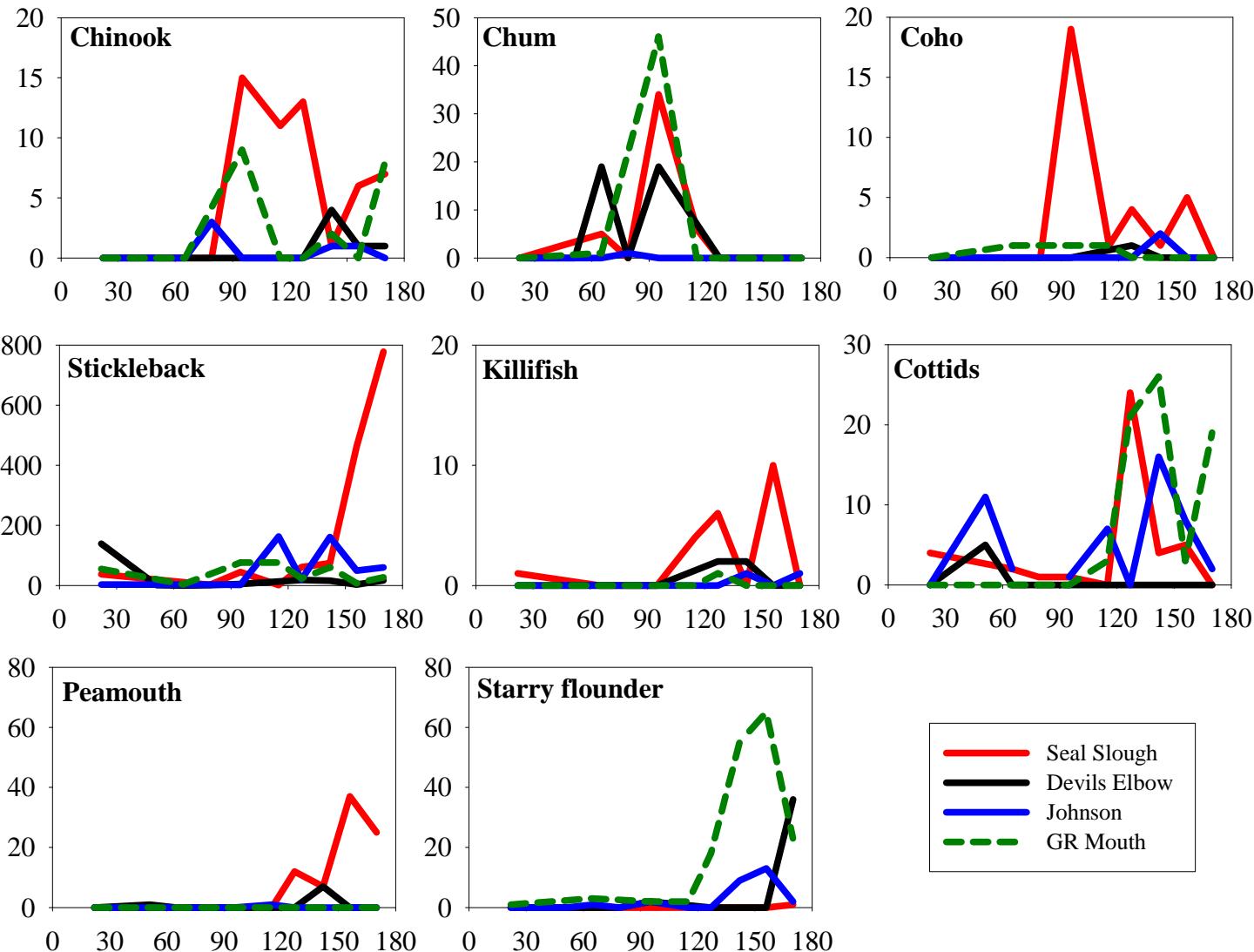


Fork length (mm)

Kandoll Farm: Chum and Coho diet

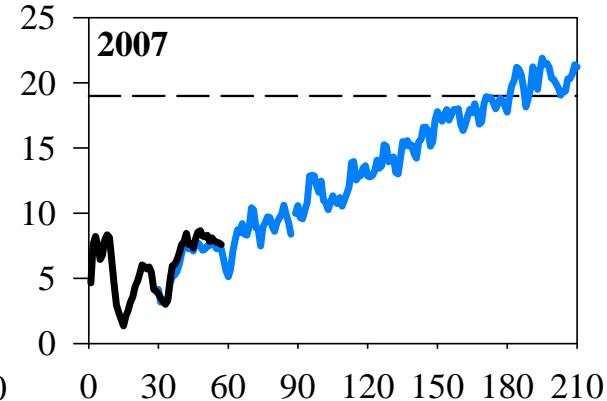
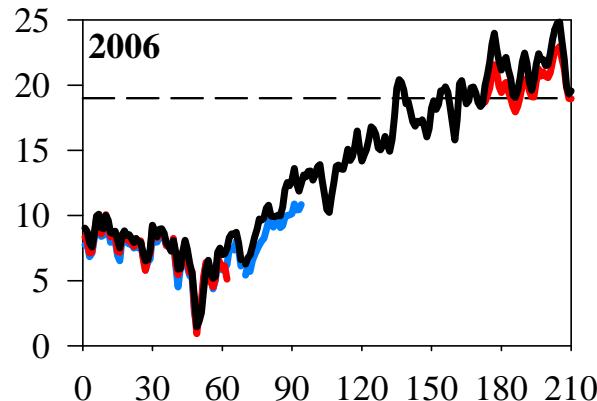
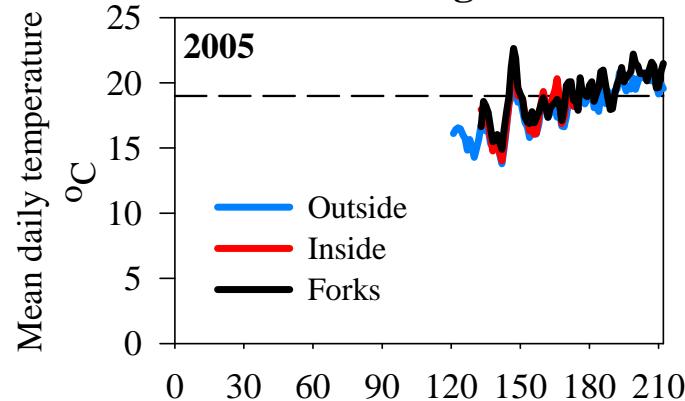


Fish abundance in the Grays River

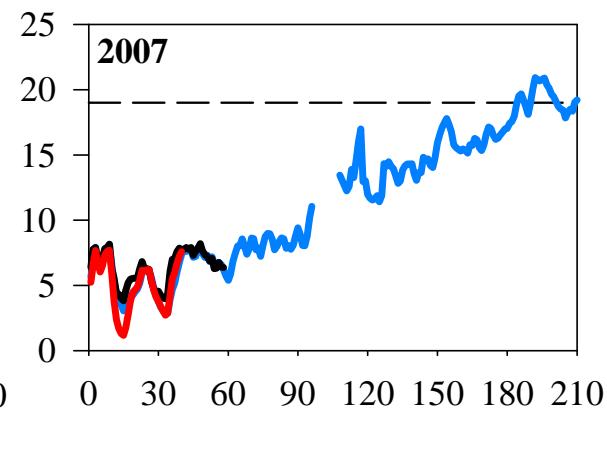
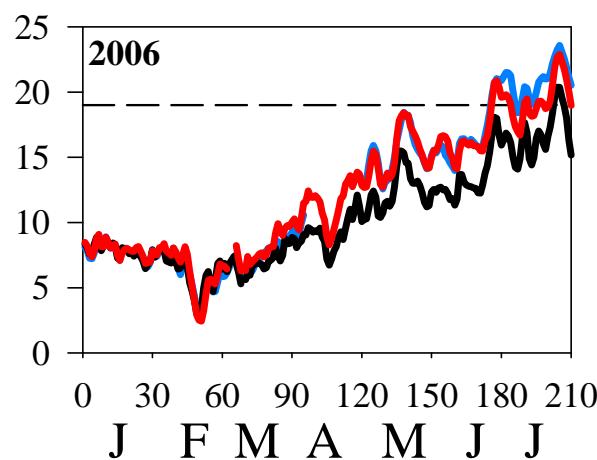
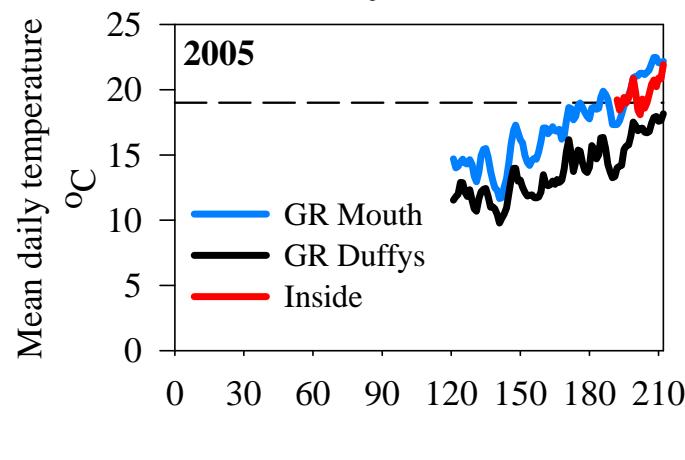


Mean water temperature

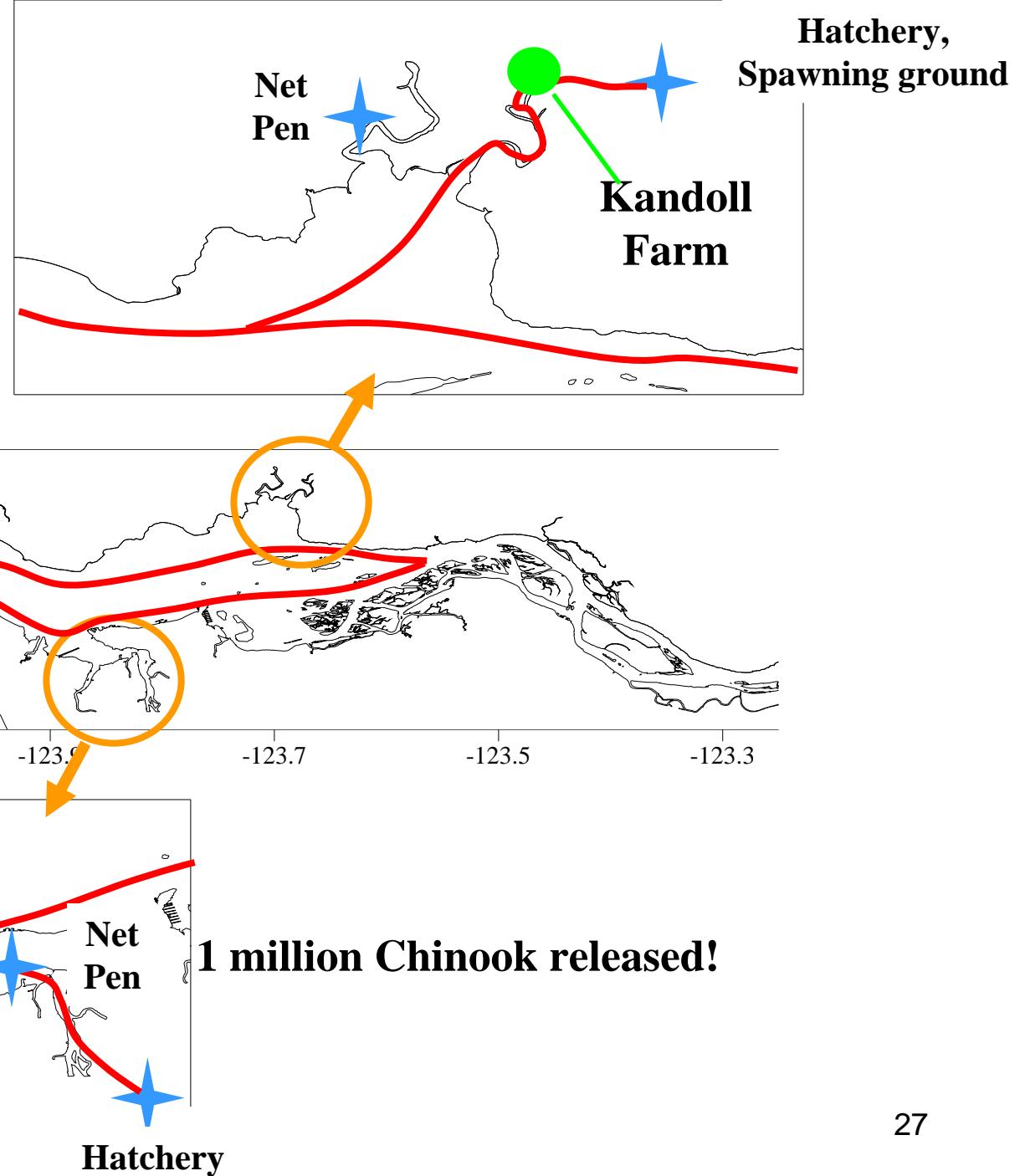
Vera Slough



Grays River



Restoration sites relative to migration corridor



Lessons learned re salmon habitat:

- 1. Restore connectivity & fish rapidly utilize habitat.**
- 2. Location matters!** Increased direct benefit for sites along salmon migration route.
- 3. Species-specific** habitat use ~ life-history characteristics
- 4. Reconnected wetlands function within the larger system and produce & export** material beneficial to salmon.





